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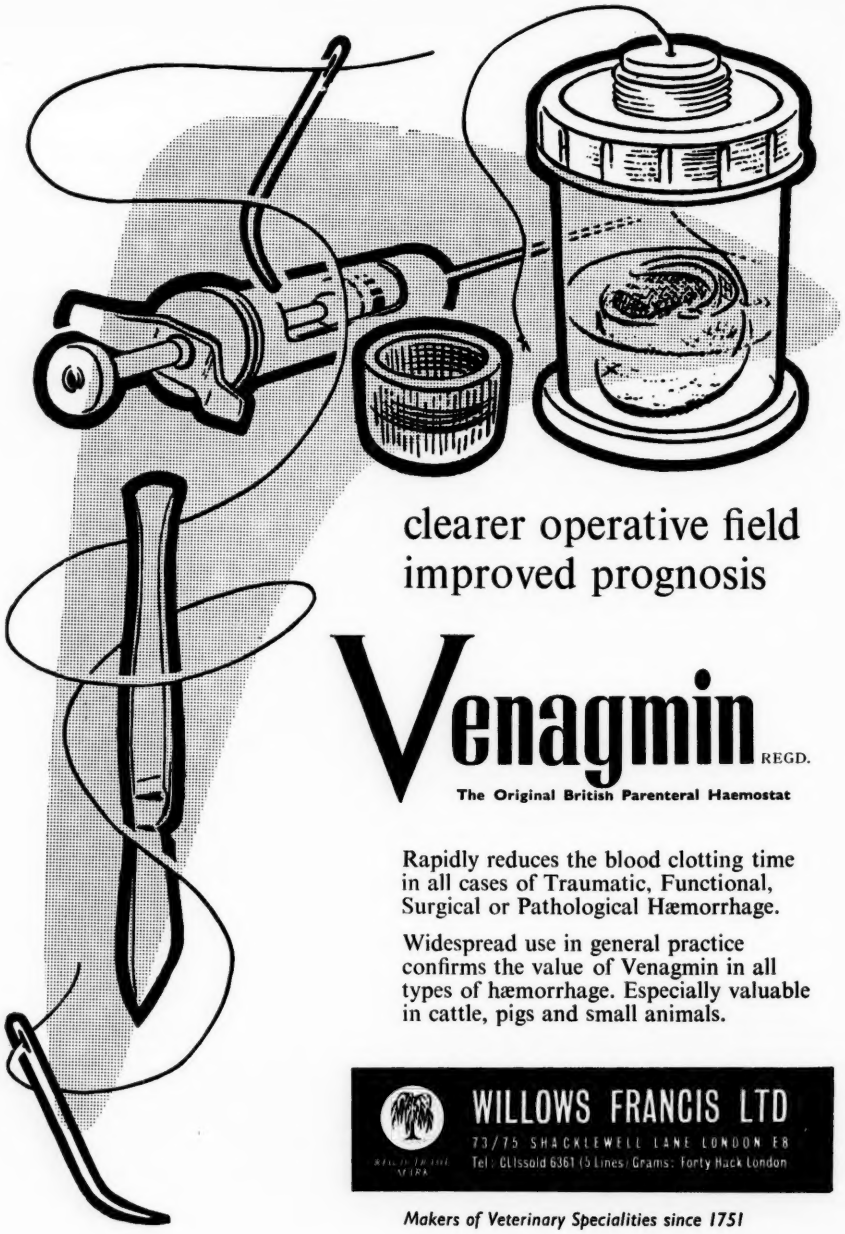

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EDITORIAL

THE FREEDOM OF THE SCIENTIFIC PRESS

One of the cherished possessions of the English-speaking people is enshrined in the independence and freedom with which they can express their opinions and views through the medium of the Press. It matters not if those opinions conform with current accepted views or with the policy of those who hold the reins of power, for a democratic community is founded on the principle that all men are free and this freedom implies freedom of conscience, of speech and of the written word. Now there are some necessary qualifications to this measure of liberty but they offer no unreasonable bar to men of good renown. Any expression of opinion must be made in good taste and be free of scurrilous or libellous content, and if these tenets are observed with strict rectitude nothing but good can come from our cherished freedom.

So far we have dealt with this matter in general terms and only as it affects the public press. Whilst the scientific press has to observe these wise rules, other problems face editors and publishers and particularly those who are associated with publications which circulate amongst those who labour in the medical field. Medical men, and in that term we include veterinary surgeons, shoulder very special and onerous responsibilities. Their work is concerned with sentient nature. They guard the health of their patients and succour those that are sick. Their task requires the stimulus of a vocational urge, a true appreciation of duty, great responsibility, integrity, and kindness, and the will to render service at all times. In ancient times their factual knowledge was not great and many of the famous physicians of those days would be ranked, by modern standards, as charlatans whose success was proportionate to their aptitude to employ the psychological approach in order to elucidate the problems which confronted them.

As sound factual information was accumulated the empirical methods of enter-

prising individuals, which had served quite well in their time and indeed were the foundation of much of the present-day store of knowledge, tended to be thrust on the discount side of the balance sheet and be replaced by the rigid school of orthodoxy based on those things which had achieved a general acceptance. In broad terms the cult of orthodoxy, as applied to scientific pursuits, may be defined as the acceptance only of those things which have been proved or acknowledged. In the medical field it can be applied also to methods of procedure. There is no doubt that science has gained much by the rigid adherence to this code but there are some who who think that the system may tend to encourage and foster a " one track outlook " and stultify the imagination and vision of workers who are afraid, often for personal reasons, to step aside from the rut and look over the hedge. There have been many occasions in our history when great new discoveries were almost blasted at their birth by the forces of orthodoxy. The most recent incident relates to Flemming's discovery of the first potent antibiotic. Many discoveries in all branches of science have emanated in the brains of individual workers who have rebelled against the discipline of the herd. It may be that in many cases the dreams and visions of the lone star worker come to naught when they are put to the test of appraisement. On the other hand it may be that good results are obtained for which, according to the state of fundamental knowledge, there may be no explanation. Such results however can justify further inquiry which might lead to great things, for research workers are not constrained to work in a forwards direction always, a passage now and again in reverse is often beneficial.

This brings us to the point of this Editorial. Articles should not be rejected because they rebel against orthodox views. All workers should have the chance to air their views and opinions as long as they abide by the accepted code of conduct. If the fresh winds of individual contributions are rejected out of hand progress may be slowed down. Past experience has shown that the old aphorism " A pearl may be found in a frog's head " gives expression to much that has been proved to be true.

IRREGULAR PATTERNS OF THE ANSA SPIRALIS OF THE SHEEP COLON

By R. N. SMITH

Department of Veterinary Anatomy, The University, Bristol 8.

THE large intestine between the cæcum and the rectum can be divided into three regions, the colon primum or ascending colon, the colon secundum or transverse colon and the colon tertium or descending colon. In the Artiodactyla the colon primum is long and itself consists of three parts, the ansa proximalis, the ansa spiralis, and the ansa distalis (Fig. 1). The ansa spiralis usually consists of centripetal coils followed by centrifugal coils and it is fixed firmly to the common mesentery which suspends the jejunum and ileum as a fringe round its periphery.

In the sheep the last centrifugal coil is separated from the remainder of the ansa spiralis by a space in which the common mesentery carries the major blood vessels and lymph nodes. This final coil is in fact contiguous to the jejunum and ileum.

A survey of a large number of sheep intestines has shown that while the majority have a regular spiral arrangement of the ansa spiralis a considerable proportion show some deviation. The regular arrangements have been analysed in an earlier publication (Smith 1955). This paper gives the results of an investigation into patterns which are not completely regular spirals.

Materials and methods

One thousand and sixty-one sets of sheep intestines were examined within a few hours of slaughter, and a record made of the pattern of the ansa spiralis seen from the left side. All diagrams given are made of this view.

Observations

Some deviation from a regular pattern was seen in two hundred and nineteen specimens. These could be divided into three groups:

(*a*) those with irregularities in the last centrifugal coil only.

(*b*) those with irregularities in any part of the ansa spiralis except the last centrifugal coil.

(*c*) those with irregularities in the last centrifugal coil and also in some other part of the ansa spiralis.

Group (a): irregularities in the last centrifugal coil only.

Fifty-six specimens were in this group. The irregularity was in the shape of ʔ, S or a combination of the two as shown in Fig. 2 A. It varied in size and position but never occurred in the cranial quadrant of the coil. The distribution is shown in Fig. 2 B where it will be seen that most were dorsal. Three specimens had more than one irregularity in the last centrifugal coil; this accounts for the total of irregularities in Fig. 2 B being more than fifty-six.

As only the last centrifugal coil was irregular the number of centripetal coils could be recorded and is given in Table 1.

FIG. 1

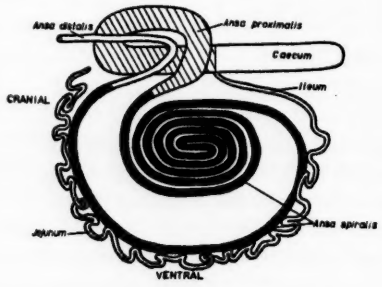
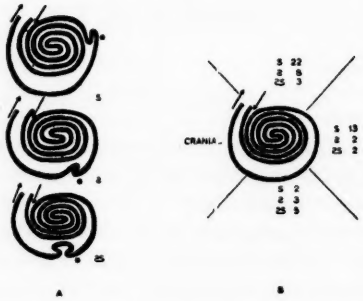


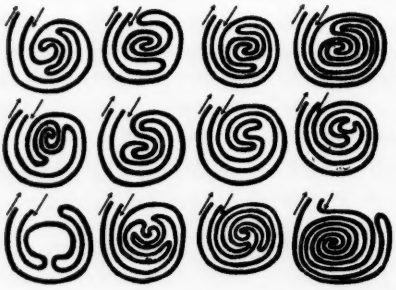
Diagram of the left side of the colon primum and adjacent structures of the sheep.

FIG. 2



(A) Types of irregularity seen in the last centrifugal coil of the ansa spiralis. (B) The frequency with which these irregularities occurred in each quadrant.

FIG. 3



Examples of the patterns of the ansa spiralis which are irregular in any part except the last centrifugal coil.

FIG. 4

Examples of the patterns of the ansa spiralis which are irregular in the last centrifugal coil and in some other part of the ansa spiralis.

TABLE 1

Pattern	Group (a)		Large survey	
	(i)	(ii)	(i)	(ii)
2 centripetal coils	9	16	2	0.2
2½ centripetal coils	19	33.9	145	17.2
3 centripetal coils	24	42.9	516	61.3
3½ centripetal coils	4	7.1	173	20.5
4 centripetal coils	0	0	6	0.7
Total	56		842	

Specimens in Group (a) arranged in order of the number of centripetal coils compared with those seen in the large survey. In column (i) the number of specimens is given; in column (ii) the number is expressed as a percentage of the total.

Group (b): irregularities in any part of the ansa spiralis except the last centrifugal coil.

One hundred and forty-five specimens of this group were seen. The extent of the irregularity varied considerably, from a small region of the otherwise normal spiral to a complete departure from a regular pattern. Many patterns occurred more than once, altogether sixty-nine different ones were observed. Some of the patterns seen are given in Fig. 3. Only one specimen was seen with a complete reversal of this part of the ansa spiralis. As in most cases it is difficult, and often impossible, to say where the centripetal coiling ends and the centrifugal begins no details of the number of centripetal coils are given.

Group (c): irregularities in the last centrifugal coil and in some other part of the ansa spiralis.

Eighteen specimens of this type were seen. Some examples are shown in Fig. 4. It will be seen that some of the patterns in Group (b) occur in this group with the addition of an irregularity in the last centrifugal coil.

Discussion

There is a large number of specimens in which only the last centrifugal coil is affected and it is interesting to note that this part of the ansa spiralis is remote in position from the remainder of the spiral. It is not improbable that it is subjected to different circumstances of formation and indeed this is found to be the case. Studies of the development of the colon of the sheep show that the last centrifugal coil appears in its final position some appreciable time before the remainder of the spiral is formed (personal observation). As we have here an isolated coil it may be possible to surmise whether or not the irregularity is due to a local overgrowth of part of the gut tract or whether it is just a local misplacement. If we compare the frequency of the patterns of the centripetal coils found in Group (a) with those found in the general survey we arrive at Table 1. It will be seen that in the 'irregular group' there are many more with the smaller number of coils (two and two and a half) than one would expect and many fewer with the larger number of coils (three and a half). It does appear then that to allow an irregularity to form, all or part of at least one normal coil must be sacrificed. In other words an irregularity is probably formed by the misplacement of part of the intestine and not by an abnormal rate of growth of a specific region. If the latter had occurred there would be much closer agreement between the number of centripetal coils found in the 'irregular' group and in the general survey.

Usually the loops and kinks seen in this part of the intestine in its early stages are drawn out to form a smooth coil as embryological development proceeds. As it has been shown (Smith 1957) that it is unlikely that the coil will alter after it is fixed to the mesentery, we must assume that it has been unable to remove all its loops before this adhesion takes place. This may be due to tardiness on the part of the intestine or to precocity on the part of the mesentery.

It is not improbable that all the irregularities form in this way. In its formation the ansa spiralis passes through several stages which resemble some of the irregular

patterns. It is possible that instead of proceeding to their final regular form these become permanently fixed in an irregular state.

The reasons for this appearance of irregularities, indeed, for the appearance of spirals with differing numbers of coils are not known. The part played by heredity is under investigation.

Summary

In a survey of the pattern of the ansa spiralis of over a thousand sheep just over two hundred were irregular in some way. Approximately a quarter of these had only the last centrifugal coil affected. It is thought that the irregularity occurs because the loops and kinks seen in early developmental stages are not removed before the ansa spiralis becomes fixed to the surface of the common mesentery.

Acknowledgements

I am grateful to Professor Ottaway for the interest he has shown in this work and to Miss B. Vowles, Mrs. V. Greenham and Mr. A. Coombs for their assistance.

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THE DOPING OF RACE HORSES

A Survey of Some Existing Information and Some Personal Experiences

By ROBERT G. MARES, M.R.C.V.S., D.T.V.M.

Introduction

AT a recent meeting of a certain turf club in Africa a horse fell during a race and died on the course. A post-mortem analysis of the bowel content revealed the presence of appreciable quantities of amphetamine, better known as benzedrine. Thus the people of an emergent African nation showed that they were no less slow at learning bad lessons from the West than good ones; doping had arrived.

The problem of controlling it at once engaged the attention of the turf club and saliva samples were taken and submitted for analysis. Later the so-called "receiving barn" was instituted (Carniglia, 1946) and horses had to be in a controlled enclosure at least two hours before the first race. The practice did not stop and so the writer offered to find out more about the way that doping was controlled in other countries and to advise the stewards further.

A leave in the United Kingdom was used to make personal contacts with people connected with the turf; literature was studied and visits were made to race courses, research stations and laboratories. The writer became, as it were, a one-man commission on doping. The limitations of a one-man commission will be obvious and so no acknowledgements are made for verbal evidence although a written record

of it has been kept. The writer's personal experiences are limited, but the apparently few references to the subject in British literature has encouraged him to quote from other sources.

Historical

The practice of doping is probably as old as racing itself. Croisier (1948) refers to a regulation to control it in England in 1666, but it does not seem to have assumed prominence until the start of this century. Then American trainers introduced it into France and the successes of their horses were often attributed to doping in spite of the fact that they also employed newer training methods and lighter racing plates. In 1904 German racing regulations forbade the use of drugs, injections or any secret means, mechanical or electrical, to increase the horse's speed (Croisier op. cit.). According to Hennau (1946) doping was heard of for the first time in England in 1896, and Americans practiced it in Austria-Hungary in 1910 where a Russian chemist obligingly produced positive results from the horses already suspected. He returned to Russia, however, without disclosing his methods! The inquiries of Kauffmann and the French commission between 1911 and 1913 confirmed that it was possible to detected alkaloids in the saliva so that control could be exercised. In 1921 the conclusions of the French commission were considered in Australia and the "receiving barn" instituted (Stewart, 1951). Saliva testing was first introduced into Florida by Catlett in 1932 (Catlett, 1939). In the 'thirties doping was a big problem in America; stables were equipped like pharmacies and such prescriptions as the following were in common use:

Heroin	... ...	1.5 gr.
Strychnine	...	2.5 gr.
Nitroglycerine	...	2 min.
Tinct. Digit	...	5 min.
Kola nut	... ...	2 oz.

Half was to be given half an hour before the race and half in ten minutes time. Concern at such practices led to saliva testing being adopted by the National Racing Association of the United States, and in each State today a veterinary surgeons takes routine samples to send to the designated laboratory (Newman, 1938).

In 1947 the committee of the Australian Jockey Club appointed a full-time official analyst and established its own laboratory. At Randwick race course there is a veterinary hospital as well as two quiet bedded loose boxes reserved for the collection of samples, and all the principal racing clubs have adopted regulations to prohibit doping and to inflict penalties on guilty persons (Stewart op. cit.). Turf clubs in many parts of the world had bad doping records in recent years until firm action was taken by the stewards after receiving analytical reports on positive saliva samples. The following instances show that much remains to be done. In one country code telegrams did not prevent interested parties knowing the results of analysis before the stewards; in another, samples have been opened and drugs added after handing to the stewards; in another, cortisone was in use for horses before its free supply for human use; in another, officials have been offered bribes not to send samples to the analyst; in another the stewards fear to take action against influential owners, and if a horse is warned off one track it is welcomed at

the rival institution. The death of a horse racing under the influence of benzedrine was reported from Rio de Janeiro (Bethlem and Taveira, 1954) and in the United Kingdom there is news of a trainer loosing his licence from time to time, while the stewards of the Jockey Club have just requested that the number of veterinary surgeons employed at race meetings should be increased to three. This, among other things, is " to act as a last minute check against ' nobbling ' " (*Vet. Rec.*, 70, 272).

Definition of Doping

Stewart defines doping as follows: " The administration to a horse within 48 hours prior to racing of any drug or other substance capable of affecting its speed, stamina, courage or conduct " (Stewart, op. cit.). Croisier, on the other hand, after considering mechanical means of stimulating a horse such as electrical spurs, and mentioning the barbiturates, comes to the conclusion that doping consists only of the administration of alkaloids, glucosides, caffeine and neuro-muscular excitants. The writer is of the opinion that mechanical means of stimulation should be controlled as strictly as doping. For example, the jockey he caught in the weighing room with tin-tacks in the end of his whip should have been warned off and his owner and trainer penalised as severely as if dope had been detected in the horse's saliva. The Belgian rules of racing as cited by Hennau (op. cit.) give by implication the best definition of doping: " It is forbidden to give, or to cause to be given . . . on the day of the race, and with that in view, any stimulant or depressant whatsoever by any route. The use of methods . . . other than the rational ones of training, hygiene and breeding is forbidden, as are all drugs . . . which can artificially augment or diminish the performance of the horse. Further, all mechanical and electrical apparati used to this end are forbidden ". It will be more difficult to control this kind of " doping " than that defined by Croisier, and these rules also rule out the use of cortisone which is said to be on the increase. It is reported that a phenomenal and unexpected win followed by a period off form is the result of a high protein diet, daily injections of vitamin B12, culminating in a deep intramuscular injection of cortisone shortly before the race. The vitamin is said to help increase the glycogen reserves and the cortisone to mobilise and consume them to produce energy during the race. At the time of writing no definite conclusions could be obtained from the turf and racing analysts as to whether this was " doping " or not.

Methods of Doping

The American magazine *Life* published an interesting article on the subject in 1955 mentioning the use of apomorphine, leptazole and adrenaline in oil, all of which are difficult to detect in the saliva (Kater, 1955). Herd and Mundy, the official analysts to the Jockey Club, showed the writer the drawer of a filing cabinet which was full of references to other drugs that could and had been used. Most of the drugs commonly used are familiar to professional men and need not be detailed here.

Drugs may be administered by all the various injection routes, by nerve blocking, drench, bolus, capsule, enema, suppository, massage and aerosol spray. Long-acting injections in oil, or slowly disolving capsules overcome the immediate pre-race supervision in the " receiving barn "—the trainer or owner making much

of his horse in the paddock and patting its neck may well be in the act of releasing adrenaline from the oily injection! In Africa the use of a primitive enema pump is popular before racing, partly from the not illogical belief that a horse runs faster with an empty bowel, but also to give various herbal infusions. One horse died after such treatment with symptoms suggestive of aconite poisoning.

Physical methods which have been used include ice packs to sore tendons, electricity, nuts under the saddle and blister ointment between the thighs.

Depressants such as the barbiturates are used to keep a horse below form until required to win, and to get a difficult horse under starters orders. Methods for their detection are known.

Stimulant drugs are those most commonly used, however, and Herd and Mundy have detected atropine, cocaine, caffeine and benzedrine in saliva samples taken by the writer. Heroin, morphine and related drugs are stimulating in the correct dose and " Pervitin " (methylamphetamine) will make a horse gallop until he drops and may be given as a very small pill in a tit-bit (Hennau, op. cit). Caffeine is probably used more frequently than any other.

Dangers of Doping

Most doping is done by the ignorant in the wish for easy money. Croisier (op. cit.) claims that it is dying out in France due to the realisation of its dangers; but he was writing before cortisone was in common use and his definition of doping is somewhat narrow. Doping with the older drugs may make a good horse just that little bit better but it will never get a three-legged cab horse into the winners' enclosure, which is what the small-time African and Syrian owners seem to expect. " Doctor give me something to make him *strong* ", is a request the writer has often to refuse as it really means " Give him something to make him *win* ".

Constant use of drugs will cause depression and make exact vision difficult. Masking of pain during the race will predispose to accident. The safety margin with drugs such as strychnine can easily be passed giving toxic symptoms. Digitalis is cumulative and other dangerous drugs which have been employed include arsenic, phosphorus in various combinations and alcohol in the form of a good stiff measure of champagne in France! The use of sex hormones may prejudice fertility and soften the bones as may the use of parathyroid hormone. The careful breeding selection of generations will go for nothing if horses are sold to stud are a result of an artificial performance brought about by the use of vitamin B12 and cortisone. DeCorganoff and LeBass report that rats could be made to swim further by the use of corticotrophin (ACTH) but it produced symptoms of collapse and œdema when they tried it on a horse. Two fatal results from benzedrine have already been cited. The dangers are in fact self evident and Hennau (op. cit.) even goes so far as to claim that the ultimate debility of repeatedly doped horses will pass on to the next generation.

Detection of Doping

The behaviour of a horse is not, in the writer's experience, very helpful except when the horse and its attendants are well-known to the officiating veterinary surgeon. When he first started taking saliva samples the stewards frequently demanded

them when a horse unseated its jockey or broke through the tapes and as a rule such samples were negative. At this club, however, where the same horses ran week after week it soon became easy to spot a change in a well-known animal. But it was surprising how often a positive result came from a horse that showed nothing abnormal either before or after the race. Most of the horses detected as being doped before the race had received so much that it was obvious that they must be scratched as unfit. Such an action does not make the veterinary surgeon popular and a colleague had once to leave the club premises as a result of an ugly demonstration when he scratched the favourite. In a few cases the bleb of the injection has been seen on the side of the neck or a man has been caught " red handed " by the supervisors in the " receiving barn ". But they are usually much too busy chasing small boys, watching the races or placing bets to be of much use.

The clinical signs of doping are said to be more reliable when interpreted by the experienced veterinary surgeons employed by the Jockey Club, as they deal with thoroughbred horses whose reactions to all stimuli are more marked than are those of country bred animals. These veterinary surgeons also find a knowledge of the individual horse's pedigree and history invaluable. Horses belonging to certain blood lines, for example, sweat more profusely than others.

Therefore when suspicion falls upon a horse doping must be confirmed by the analysis of samples. Methods of collection have been described by Stewart (op. cit.) and Newman (op. cit.); methods of analysis have been described by Moore (1957). A Jockey Club veterinary surgeon is present at every meeting in the United Kingdom and samples are taken only if there is suspicion. The penalty is very severe; loss of trainer's licence. In other countries routine samples are taken from every winner but punishment may only amount to a fine.

The main requirements for taking saliva samples are to have proven chemically pure materials, to swab the mouth as completely as time allows and to have a fool-proof system of sealing and identification. To control doping properly the taking of urine and blood is essential; but the former is time consuming and the latter out of the question as owners would never tolerate it. At the moment cortisone and sex hormones cannot be detected except by taking comparative steroid values of urine and plasma (Carniglia, op. cit.). Facilities for all these procedures could well be improved everywhere. In particular in smaller Commonwealth countries and colonies, where private veterinary practitioners are few or absent, turf clubs should employ full-time veterinary surgeons and provide all reasonable amenities.

The analysis of samples must be done by a qualified analyst. Analyses require expensive electrical equipment and some of the tests take twenty-four hours or more to complete, during which time the apparatus must be under supervision or in a locked room. Newman states, " It is by no means a veterinary surgeon's job to analyse samples " and Stewart confirms with: " The detection and identification of an alkaloid in a sample of saliva in fractional quantities is a highly specialised procedure " (op. cit.). The veterinary surgeons part is to examine horses before, during and after racing, to advise the stewards when a sample is indicated and to take such sample in the presence of witnesses, and seal and hand it to the stewards for despatch to an approved analyst.

Control of Doping

Carniglia (op. cit.) asks "Can racing be cleaned up?" One is tempted to reply with another question: "Should racing be cleaned up?" Doping is practiced by the poor, ignorant, seedy and greedy of the racing underworld and with better education it should die a natural death. The racing public go to gamble and the possible use of dope is only another imponderable to add to the state of the going, the luck of the draw, the instructions to the jockey and the ability of the other horses. Doping has been going on for many years in many places without detracting from public enjoyment. The good horses win and the bad horses loose in spite of all efforts to the contrary.

But the harmful effects of doping on the horse make it essential that the practice be controlled on humanitarian grounds. To control it in Africa legislation and education are required. Turf clubs should employ full-time veterinary surgeons and then they will have an unique opportunity to lead the way in the education of the unsophisticated horse owner. Horse husbandry and disease prevention should be treated as of equal importance with clinical work. Turf clubs should form regional boards of racing control to frame and enforce the rules of racing. If a club trys to improve matters by itself it will merely be cutting its own throat as horses and trainers will race elsewhere. Penalities should touch owner and jockey as well as trainer. In Africa jockeys often act against instructions either to try win or to loose. The African trainer is less of a true trainer than is his counterpart in England, but he is more of an agent or middleman and is expendable.

It is certain that doping could be greatly reduced by first providing all facilities, then making it very clear that it was intended to take samples and finally making a really good example of the first case brought to light, even flying out lawyers and professional witnesses from the United Kingdom. The use of the "receiving barn" alone is not enough. To the man in the street it appears as if the turf club in the tropics is making and spending large sums of money on improving facilities for the patrons. More should be done for the horses who run round the same white rails week after week for public enjoyment and private profit.

Acknowledgements

The international and inter-racial board of stewards of the turf club concerned showed a real interest in this work and gave permission for publication provided their club remained anonymous. They are doing their utmost to obtain the services of a full-time veterinary surgeon to carry out the advice given. The Director of Veterinary Services has always shown a great interest in the affairs of the horse and permitted me to act as honorary veterinary surgeon to the club and to publish my observations. Messrs. Herd and Mundy have been most helpful at all stages. Miss Rayner, of the Royal College of Veterinary Surgeon' library, found all the references and many colleagues wrote long helpful letters or gave of their time for interviews. A decent interval has elapsed between the few events described and publication.

Summary

The doping of race horses is considered under the following headings: history, definition, methods, dangers, detection and control. The consideration of control bears special reference to a certain part of Africa.

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THE WEYBRIDGE PATTERN ARTIFICIAL VAGINA

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To obtain semen for evalution, biological investigation or artificial insemination, it is usual to stimulate ejaculation by means of an artificial vagina. This consists of an outer tubular casing and a removable liner of rubber or rubber-latex, which is longer than the casing so that its end portions can be turned back and stretched over the outer ends of the casing. The casing has a screw-threaded perforation and plug of about 1.5 cm. in diameter. The plug can be removed so that warm water may be introduced through the aperture and into the space between the liner and casing. When there is a sufficient volume of water around the liner to exert the desired pressure on the penis and when the temperature and lubrication of the lumen are satisfactory, this apparatus is efficient in stimulating ejaculation. A receptacle for the ejaculate is attached to one end of the apparatus. This may be a bottle or, more commonly, a rubber or rubber-latex funnel which leads to a glass tube.

The increased pressure developed within the casing during use tends to force the contained water between the ends of the casing and the end portions of the liner. This causes these portions to slide off the casing, and the semen collecting tube to become detached also. To prevent this, it is usual to place strong rubber bands onto the stretched-on ends of the liner, the collecting cone and semen collecting tube. To ensure that the bands cannot slide off and encircle the penis, it is advisable to tie tapes between the bands which are at opposite ends of the casing. Alternatively, string, tape or metal bands may be used.

Although such an artificial vagina is simple in structure, it is not easy to assemble satisfactorily for safe use. Initially the apparatus is relatively cheap, but it is costly to maintain because of the perishable nature of the liner and collecting cone which do not withstand repeated sterilising temperatures readily. The most unsatisfactory feature of this type of apparatus is that it fails to protect the ejaculate which it is intended to collect. A sample of semen can be lost easily because of displacement or breakage of the collecting vessel and it is difficult, if not impossible, to protect the ejaculated spermatozoa against a sudden reduction in temperature when they come into contact with the collecting tube. Temperature shock is considered to be detrimental to viability. A variety of materials, wet or dry, can be wrapped around the collecting vessels to reduce this risk but their value is doubtful and their use generally increases the already existing clumsiness of the instrument. Because of its general clumsiness and over-all length, the present type of artificial vagina is not as easy to handle as it should be. There are potentially dangerous features and structually it is weak in a number of places.

A new type of artificial vagina has been designed in order to eliminate the unsatisfactory features. For the new apparatus, the Weybridge Pattern Artificial Vagina, the Crown as applied for provisional patent protection under application No. 18646-57. It has a liner composed of an impervious flexible material, such as "Nylon", which will not deteriorate rapidly when in use or as a result of sterilisation. The semen collecting tube is positioned within water-jacketed region so as to prevent temperature shock to the semen. Preferably, the entry to the A.V. should be cushioned and the orifice elliptical. The arrangement may allow that the liner can be removed and replaced.

In one design the A.V. has an outer tubular casing of "Nylon" or other suitable flexible material so that the casing will be capable of yielding slightly under stress and provide for satisfactory handling. This tubular casing has, at one end, an in-turned annular radial flange which carries a sleeve that extends axially for a short distance into the casing and is provided, at that end which is remote from the flange, with a flared or funnel-shaped entry. Radial fins are cast between this sleeve and the outer casing, one of these fins being provided with a radial passage so that a vent is formed from the inside of the liner to the atmosphere to allow escape of air during use. One end of a tubular liner is joined to the inner surface of the sleeve and the other end to the vulval extremity of the casing. The flared end of the sleeve acts as a guide to the liner and to the penis, protecting the tip of the penis against injury if the bull thrusts abaxially.

Formed upon the part of the annular flange surrounding the central opening is an outwardly projecting hollow boss which is virtually an extension of the inner sleeve and liner. Fitted into and screwed upon this screw-threaded boss is a mushroom-shaped stopper having a hollow stem which passes into the sleeve and either constitutes or contains a receptacle for the ejaculate. The size of the mushroom-shaped closure is such that its outline merges into the exterior surface of the casing. The head of the mushroom is provided with a number of depressions in order to facilitate manipulation.

The filler orifice is located on the wall of the casing and has screwed into it a removable plug which may be provided with a slot to accommodate a coin to

assist removal and fixation. A part of the inner side of the annular flange is thickened to accommodate the dial portion of a thermometer, the stem of which is within the water jacket.

In the construction just described, the sleeve into which ejaculation is affected is surrounded by the water jacket and it is maintained at a suitable temperature so that the semen is not exposed to temperature shock. The stem of the mushroom closure may be graduated so that the volume of the ejaculate can be ascertained. In the case where the hollow stem of the closure contains a receptacle for the ejaculate, this is made of a transparent material and graduated.

Discussion

Artificial vaginas of the Weybridge pattern may be made in dimensions suited to the males of varying species, including bull, ram, male goat, stallion and boar. It is designed to be a permanent unit, as distinct from patterns which require dismantling and reassembly, to be capable of withstanding moist heat sterilisation and to remain in regular use without frequent replacement of individual components.

An essential feature is that the semen-collecting vessel is within the temperature environment and physical protection of the water jacket. The elimination of the risks of temperature shock and exposure to adverse factors during the collection of ejaculates allows of better preservation of the semen. The design eliminates difficulties of assembly, while the reduction in over-all length and freedom from projections and semi-loose attachments makes it easier and safer to handle, particularly under difficult conditions in the field.

The use of an elliptical entry with a capacity for dilation allows stimulation at an early stage of penetration, while the built-in cushioning diminishes the risk of damage to the penis. Should an A.V. of this pattern be dropped or knocked against a hard object, little harm can result. There is no risk of spreading fragments of glass and a sample of semen cannot be lost by breakage. The rounded end of the mushroom closure tends to glide off the hindquarters of the teaser animal in the event of poor alignment of the instrument, diminishing the chances of the A.V. being bent and causing damage to the penis within it.

Initially the Weybridge Artificial Vagina may cost more than other types, but we believe that this will be offset by reduction in maintenance charges and its technical advantages.

Acknowledgements

I wish to thank Dr. A. W. Stableforth and Mr. J. R. Lawson for their encouragement and interest. I am grateful also to Mr. P. Tilbury who prepared the attached diagram to my design and specifications.

A STUDY OF HUSK IN CALVES

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ALTHOUGH parasitic bronchitis in cattle has been studied extensively, little information is available on the precise effect of the disease on live-weight gain. The

following investigation was carried out at the Grassland Research Institute between May 1956 and July 1957, primarily to study the problem in calves.

Experimental Method

A group of eight Hereford calves, ranging from 4½ to 7½ months old, was grazed rotationally over three 1½ acre plots sown to a ryegrass/clover mixture (Short rotation ryegrass N.Z. 20 lb., White Clover N.Z. 2 lb., Trefoil 2 lb.). These animals constituted the infected group (H), and their plots were lettered A, C and E. A control group of eight Hereford calves (F) equivalent in age and weight, were grazed in similar manner on three 1½-acre plots lettered B, D and F. A 4-yard race divided the six plots, and a weighing pen was installed in the race in such a way that the groups could be kept separate during weighing operations. The experimental area was part of a 45-acre field, Seymours, sheltered on the west side by woodland.

Infection was introduced on three successive occasions as follows :

(a) Plot A was grazed for one day on May 7th, 1956, by eight infected calves, each passing approximately 1,330 larvæ (*Dictyocaulus viviparus*) per 10 g. fæces

(b) Plot A was grazed for six days, June 26th to July 2nd, by two calves passing approximately 11 larvæ per 10 g. fæces.

(c) Plot E was grazed for five days, July 9th–14th, by two calves passing approximately 480 larvæ per 10 g. fæces.

The experiment covered two major periods. The first extended from May 7th until August 20th, 1956, when owing to the shortage of pasture the removal of group F became necessary.

This period enabled a comparison between free and infected animals to be made and during the course of the experiment the animals were weighed regularly. In view of the shortage of keep between May 23rd and June 9th, 1956, hay was fed *ad lib.* to both groups. Fæcal samples were taken at intervals and the numbers of larvæ in 10 g. were estimated by the method described by Parfitt (1955). Pasture samples were taken also and the numbers of larvæ were estimated by the technique described by Michel and Parfitt (1955).

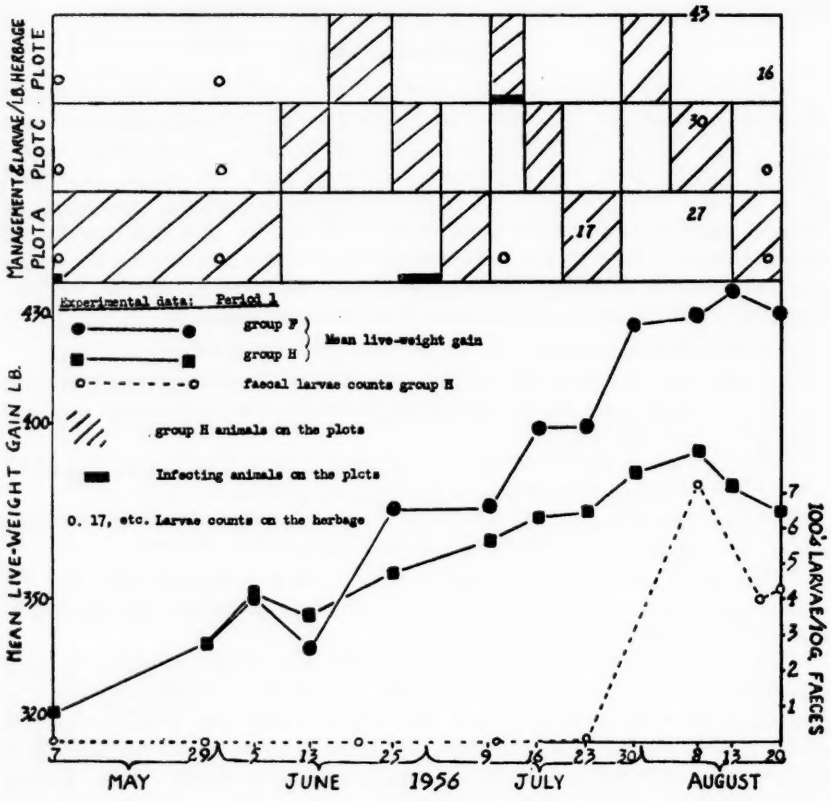
The second period extended from August 20th, 1956, to July 18th, 1957, and was concerned with the persistence of the infection and its effects on the animals in Group H.

Results : Period I (May 7th–August 20th, 1956)

Figure 1 shows the mean live-weight gains of the two groups, the grazing management of the infected plots, the estimated levels of pasture infestation, the larval output in the fæces, and the periods during which the infective calves grazed the plots. Rotation from plot to plot occurred at the same time in both groups.

The initial infection was introduced on May 7th, and 37 days later the mean weight of group H was 9 lb. heavier than that of group F. During this time the extremely short grass, the warm dry days and cool dry nights together provided conditions conducive to larval desiccation, but nevertheless 1 larva per lb. herbage was recovered on May 31st, and 1 larva per 10 g. fæces was recovered from one animal (66) on June 20th.

FIG. 1



The live-weight curves were similar up to June 13th, during which time no coughing had been noticed, nor had larvæ been detected in the fæces. Between June 13th and June 25th there was rather less keep for group F than for group H, and so group F were allowed the run of the race between the plots during this period to ensure adequate feed. On June 25th there was a mean difference of 18 lb. live weight per head between the groups and in favour of group F. It was possible that the additional grazing provided for this group accounted for some of this difference in terms of 'fill,' and the difference between the groups was reduced to 9 lb. at the next weighing (July 9th). Since conditions were not conducive to larval survival a further infection was introduced, but in retrospect this appeared to have been unnecessary.

From June 25th to July 23rd, group F gained weight rather erratically, whilst group H gained at a consistently slower rate. Larval counts on the pasture were progressively higher from July 23rd, reaching a peak in August. Data concerning individual animals are shown in Figures 2 and 3.

PLATE I

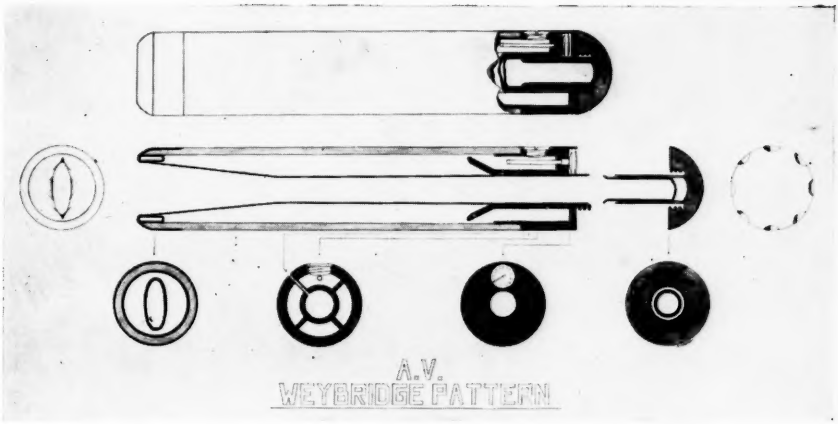


FIG. 1

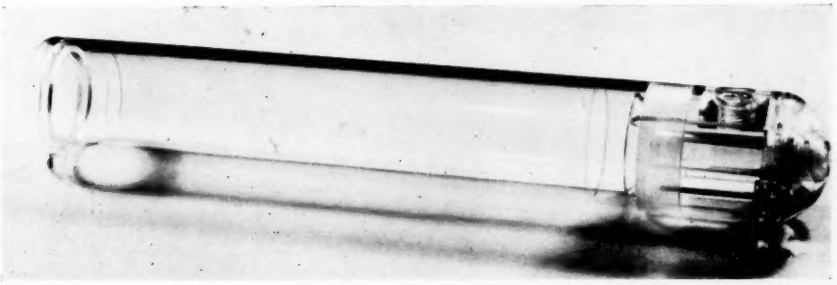


FIG. 2
General form of AV (minus liner).

(Article by P. G. Millar, on page 294)

PLATE I

FIG. 1

Apparatus used for maintaining the animal's head at the required angle. The sheep is held in a dog-sitting position with the fore-legs between the uprights. Both the height and tilt of the head holder can be adjusted.

(Article by A. C. Palmer, on page 307.)

FIG. 2

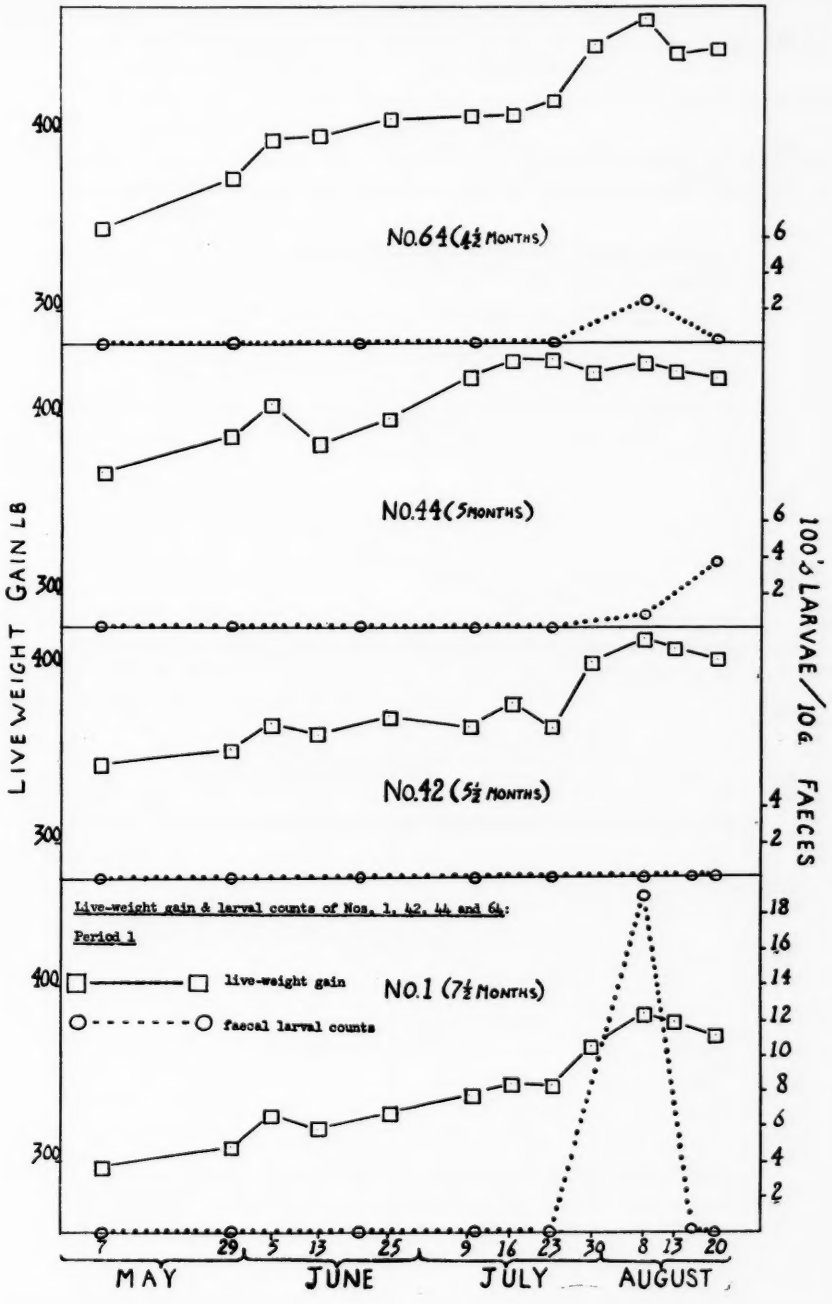

LIVE WEIGHT GAIN LB
100's LARVAE/10g. FAECES
No.64 (4½ MONTHS)
No.44 (5 MONTHS)
No.42 (5½ MONTHS)
No.1 (7½ MONTHS)
Live-weight gain & larval counts of Nos. 1, 42, 44 and 64:
Period 1
live-weight gain
faecal larval counts
MAY
JUNE
JULY
AUGUST

FIG. 3

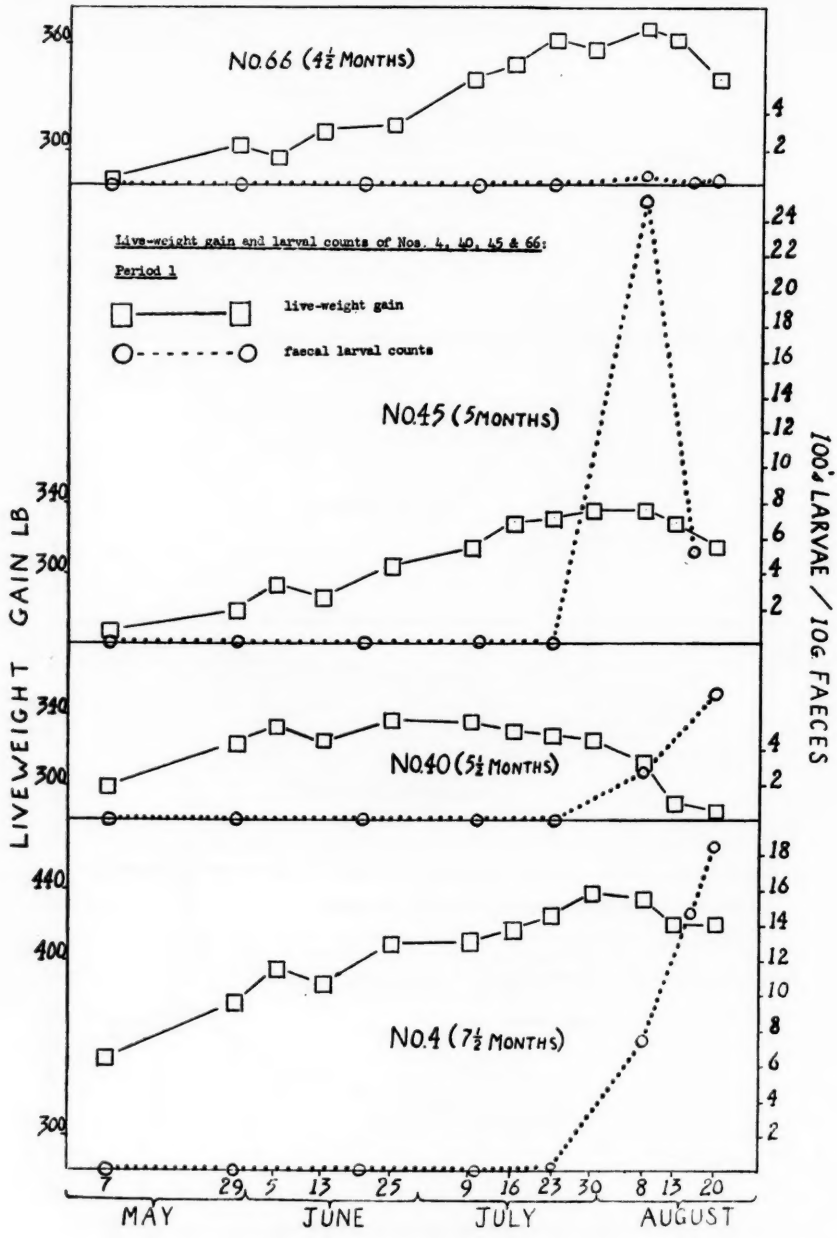

NO.66 (4½ MONTHS)
Live-weight gain and larval counts of Nos. 4, 40, 45 & 66:
Period 1
live-weight gain
faecal larval counts
NO.45 (5 MONTHS)
NO.40 (5½ MONTHS)
NO.4 (7½ MONTHS)
LIVEWEIGHT GAIN LB
100's LARVAE / 10G FAECES
MAY
JUNE
JULY
AUGUST

Table 1 shows the statistical treatment of the live-weight comparisons between groups H and F. This treatment was made on all sub-periods, viz.—

(1) May 7th–June 25th—at the end of this period the live weight curves began to separate.
(2) May 7th–July 23rd—during this period a distinct separation of the live-weight curves developed.
(3) May 7th–August 20th—the whole period of comparison, towards the end of this period a marked loss in the mean weight of Group H occurred.

TABLE 1

Statistical treatment of the live-weight gain comparison between groups H and F, in lb.

1956	Sub-period 1 May 7 to June 25		Sub-period 2 May 7 to July 23		Sub-period 3 May 7 to August 20	
Group	H	F	H	F	H	F
Group Mean	39.9	61.6	57.0	81.2	56.6	113.0
Standard Error of each mean	± 5.22		± 6.11		± 9.73	
95% limits for the difference (F - H)	5.9 to 37.5		5.7 to 42.7		26.9 to 85.9	

It will be noted that in all three sub-periods treated in this way, the gain of group F was significantly higher than that of group H. The fæcal egg-output from gastro-intestinal nematodes is shown in Table 2.

TABLE 2

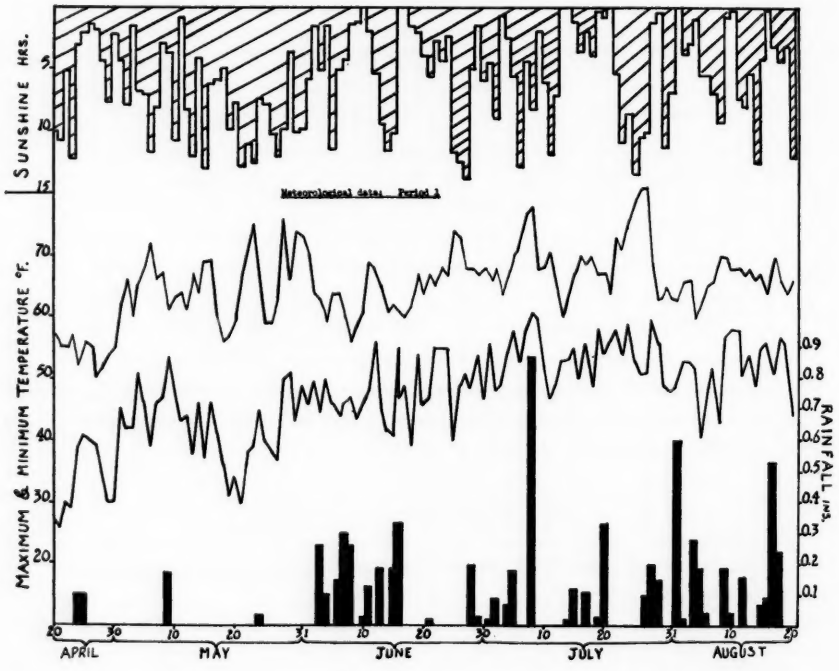
Gasto-intestinal nematodes: (Strongyloidea):
Fæcal Egg Counts (e.p. 10 g.) during Period I.

	May 7	May 29	June 18	July 24	August 8	August 16	August 20
Group F Mean	0	10	0	n.s.	19	n.s.	85
Group H							
1	0	1	0	0	200	10	120
4	0	2	0	0	400	60	50
40	0	n.s.	0	0	8000	-	-
42	0	0	0	0	0	20	20
44	0	1	0	0	400	n.s.	2500
45	0	0	0	0	500	2050	n.s.
64	0	0	0	0	250	n.s.	100
66	0	0	0	0	220	100	4000
Mean	0	0	0.6	0	1121	448	1132

N.S. no sample.

It was becoming apparent towards the end of July that a difference in appetite between the groups was accounting for a difference in the amount of grass available. Group F were constantly short of keep whilst that for group H was adequate. This limitation, which may have contributed towards the form of live-weight curve shown by group F, increased to such an extent during August, that the comparison between the two groups had to be terminated on August 20th. The meteorological data for this period are illustrated in Figure 4.

FIG. 4



Results : Period II (*August* 20*th*, 1956—*July* 18*th*, 1957)

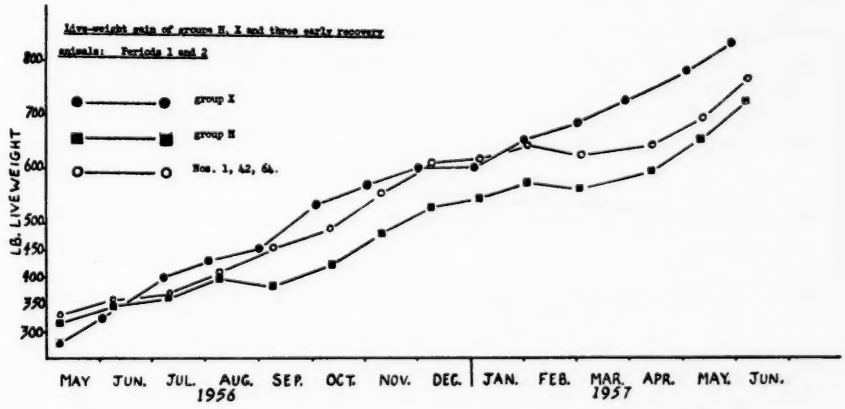
The second part of the experiment was concerned with the recovery of the animals in group H from infection. In the absence of the control group F, the live-weight of group H was compared with that of a group of animals purchased as calves from the same source, of equivalent age and subsequently managed on a similar nutritional level. This additional group (group X), although not regarded strictly as a control group, provided a useful guide in studying the degree of recovery of the infected animals, and at no time during the experimental period did they show any symptoms of husk. Group H remained on the experimental area until September 7th when additional grazing areas were provided in order to maintain a fairly high nutritional level. This additional grazing provided keep until January 25th. From

then until April 8th, group H were wintered on a small paddock and fed 40 lb. of medium quality silage per head per day, hay of inferior quality being provided *ad lib.* From April 8th until the end of the experimental period, the animals were rotated over a number of paddocks but did not return to the original experimental area.

Throughout period II the animals in group H were weighed every fortnight and fæcal samples were taken. The live-weight curves of group H and group X are shown in Figure 5, together with a curve for three calves which recovered early, Nos. 1, 42 and 64. The fæcal samples provided a means of estimating the degree of infestation by nematodes in the alimentary tract. Counts of eggs per gramme together with the live-weight curves for individuals in group H are graphically illustrated in Figure 6. (*See overleaf.*)

It will be noted that all the animals in group H were dosed on September 14th,

FIG. 5



1956, with 1½ oz. of Phenothiazine, whilst two animals, Nos. 44 and 64, received 4-oz. doses on March 1st and May 10th, 1957, respectively. In both of the latter instances the anthelmintic was given following a period of scouring when relatively high egg counts were obtained. The husk larvæ counts in the fæces for this period are shown in Table 3. (*See page* 305.)

Discussion

Period 1. From Figure 1 it is evident that a difference in live-weight between groups H and F in favour of group F appeared first on June 25th and during June and July this difference increased steadily. During the 105 days of the live weight comparison, the animals in group F gained 0.46 lb. per day more than those in group H which recovered. However, since the grazing area for the control group was inadequate, the potential difference was in all probability not attained.

FIG. 6

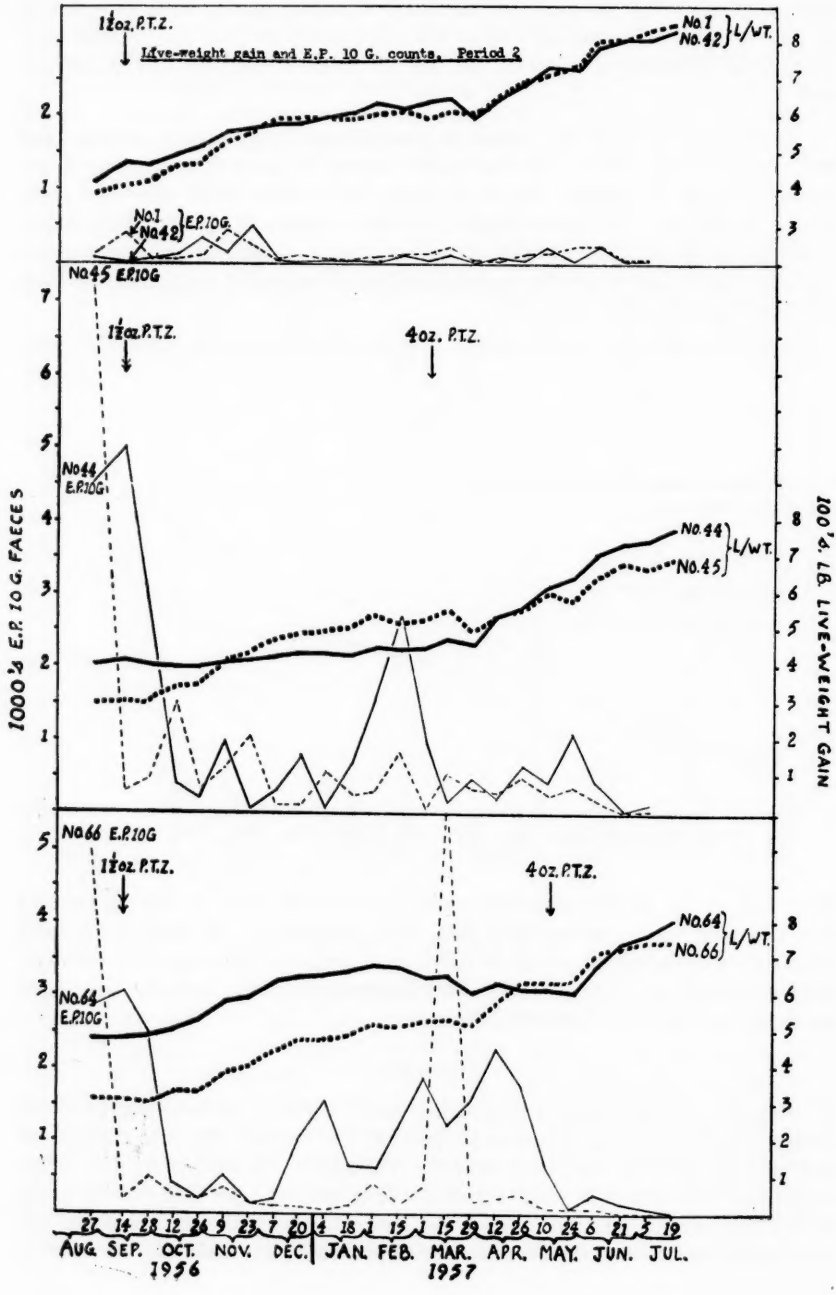

1½oz. P.T.Z.
Live-weight gain and E.P. 10 G. counts. Period 2
No.1
No.42
L/WT.
E.P.10G.
No.45 E.P.10G
1½oz. P.T.Z.
4oz. P.T.Z.
No.44
E.P.10G
No.44
No.45
L/WT.
No.66 E.P.10G
1½oz. P.T.Z.
4oz. P.T.Z.
No.64
E.P.10G
No.64
No.66
L/WT.
1000's E.P. 10 G. FAECES
100's LB. LIVE-WEIGHT GAIN
27 14 28 12 26 9 23 7 20 4 18 1 15 1 15 29 12 26 10 24 6 21 5 19
AUG. SEP. OCT. NOV. DEC. JAN. FEB. MAR. APR. MAY. JUN. JUL.
1956
1957

TABLE 3

Husk Larvæ per 10 g. fæces. Period II.

No.	27/8/56	6/9	14/9	28/9	12/10	26/10	9/11	23/11	7/12	20/12	4/1/57	18/1 to 13/7 (fort-nightly)
1	2	0	11	1	0	0	0	0	0	0	0	0
4	1240	N.S.	1080	-	-	-	-	-	-	-	-	-
40	1482	-	-	-	-	-	-	-	-	-	-	-
42	8	0	0	4	1	0	0	0	0	0	0	0
44	76	35	29	0	0	0	0	0	0	0	0	0
45	296	48	45	222	0	0	0	0	1	0	1	0
64	22	4	0	0	0	4	0	0	0	0	0	0
66	406	85	0	43	1	0	6	0	0	0	0	0

Coughing was first noted in group H early in July, and was particularly marked if the animals were moved about. It became increasingly noticeable during August, when it was accompanied by a steady loss in weight. Signs of distress were manifest particularly in calves 4, 40, 45 and 66, and it was clear that the infection had become severe. On August 28th calf No. 40 died, and on September 14th calf No. 4 was slaughtered *in extremis*. Three types of response may be distinguished within the group exposed to infection during this period.

(a) The animals declined rapidly in live-weight and did not recover (Nos. 4 and 40).

(b) The effect on live weight was more severe in the early part of Period 1. (Nos. 1, 42 and 64).

(c) The effect on live weight was more serious in the latter part of Period 1. (Nos. 44, 45 and 66).

The distinction between these conditions is not rigid. Thus Nos. 45 and 66 almost succumbed during Period II (September) whilst the response of No. 44 may have been complicated by a high intestinal worm burden. From May 7th to August 20th, the mean gain per day was 1.08 lb. for group F, 0.73 lb. for Nos. 1, 42 and 64, and 0.53 lb. for Nos. 44, 45 and 66. Of the animals that survived the latter two groups distinguished above as (b) and (c) showed a different response to the infection. Thus the mean live weight gain per day from May 7th to June 25th was approximately the same, 0.78 lb. and 0.80 lb. respectively. From June 25th to July 23rd the mean live weight change per day was 0.29 lb. and 0.84 lb., and from July 23rd to August 20th 1.12 lb. and—0.67 lb. respectively. It appeared that Nos. 1, 42 and 64 showed an earlier response to the infection in terms of a reduced live-weight gain, but over the whole of Period I they did not suffer to the same extent as the remainder of the group.

The evidence from fæcal examinations suggests that where larvæ appeared in the

fæces they did so at about the same time in all the infected animals. This might suggest that they all became infected at about the same time.

It is instructive to examine the extent to which the initial infection contributed towards the husk outbreak during August. Although the initial infection was introduced on to Plot A only, the peak of larval numbers on the herbage of all three plots occurred at about the same time early in August. The grazing pattern (Figure 1) shows that group H grazed Plot C between July 14th and July 20th, i.e. 18 days following exposure to the second infection, during which time larvæ derived from this infection would not have appeared in the fæces. Clearly the peak numbers of larvæ on Plot C represented the infection carried over by group H animals from the original infection on Plot A, and this would seem to suggest that the initial infection was of primary importance.

Michel and Parfitt (1956) have indicated that 4-month old calves exposed to an initial infection of less than one larvæ per lb. of herbage during the first 9 days' exposure are likely to recover. In this experiment, larvæ were detected on the herbage on May 31st and one larva per lb. herbage was recovered. In accounting for the death of two and the recovery of six animals, it is possible that either a ' border line ' infection was established implying a difference in resistance between animals, or that fatality depended on the intake of more or less than one larva per lb. of herbage and was a function of the animal's particular grazing pattern.

Period II. Throughout the experimental period, and particularly during Period II when husk larvæ were not being passed in measurable numbers, the effects of worms in the alimentary tract may have affected the experimental results and in general animals in which husk infection was more serious had higher egg counts.

From Figure 5, it will be seen that the mean live weight of the three animals which made the most rapid recovery (1, 42, 64) was similar to the mean of group X between December and February, 1956. In July, however, the mean weight of these three animals was some 90 lb. less than that of group X. The live weight curve of Nos. 1, 42 and 64, was very similar to that of the mean of group H from February, 1957, onwards, i.e. at first there was a considerable loss in weight followed by a recovery. It would appear that the growth of all the animals in group H during this time was affected by the same limiting factors. These may have been of either a nutritional or parasitological nature, or both. Group H showed a marked recovery in weight once grazing commenced on April 8th, 1957. This gain was sustained except in the case of No. 64. It is possible that, although at least three animals appeared to have fully recovered from husk by December in terms of live weight, the subsequent resistance to stomach and intestinal parasitism of the group, as a whole, may have been lowered. By the end of May the mean weights of Group H and the three animals, 1, 42 and 64, were less than that of group X by 135 lb. and 90 lb. respectively, the difference being increased by 55 lb. and 75 lb. from those on February 2nd. Group H did not appear to thrive on the silage/hay diet between January 25th and April 8th, although the level of nutrition was substantially the same as that for group X. The effects of husk may have been exacerbated during this change from

a high level to a lower level of nutrition, when resistance to intestinal parasitism was relatively low.

Summary

1. The effect of husk on the live weight gain of calves was studied under grazing conditions.

2. Two of the eight animals which became infected did not recover. The remainder suffered a significant reduction in their rate of live weight gain.

3. Of the six animals which recovered, the calves which suffered an *early* depression of live weight gain were the least retarded over the whole experimental period (14 months).

Acknowledgments

The authors wish to express their thanks to Dr. William Davies for facilities to carry out the work ; to Mr. C. D. Kemp for statistical treatment of the results, and to Mr. I. A. N. Wilson for technical assistance.

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A TEST FOR VESTIBULAR FUNCTION IN SHEEP

By A. C. PALMER

Department of Veterinary Clinical Studies, University of Cambridge

Introduction

NEUROLOGICAL examination of animals is beset with difficulties owing to the impossibility of testing subjective sensation. Thermal stimulation of the labyrinth in man affords an objective and quantitative method of examining the vestibular system and because of these practical advantages, it was considered that the test might have a veterinary application. The purpose of this paper is to describe the test as it has been applied to sheep and the attempts to find a set of values of the duration of induced nystagmus in normal animals.

The caloric or Bárány test is used in human medicine to examine the function of the labyrinthine end organ, the vestibular nerve and other centres. Rotational tests are also employed, but these have the disadvantage of causing stimulation of both labyrinths at once, whereas thermal stimulation can be applied to each labyrinth in turn. Thus in man, unilateral abnormalities of the vestibular apparatus can be detected.

A review of the theories of thermal stimulation of the labyrinth was given by Jongkees (1948b). In brief, the patient is maintained in a lying position, so

that the lateral labyrinthine canal (the most superficial) is in a vertical plane. The temperature of the labyrinthine region is then altered by irrigation of the external ear with water at a temperature higher or lower than the body temperature. It is believed that regional temperature changes cause convection currents in the endolymphatic fluid, which in turn deflect the cupula and cause nystagmus, the duration of which can be recorded. Irrigation with water at 30° C (the " cold " test) causes nystagmus in both eyes, with the quick component of the nystagmus movement in a direction away from the ear being stimulated; irrigation with water at 44° C (the " hot " test) results in a similar kind of nystagmus, but the quick component is towards the ear being stimulated.

Most of the investigations concerning caloric nystagmus have been conducted on man (Fitzgerald and Hallpike, 1942; Jongkees, 1948a; Hallpike, Harrison and Slater, 1951; Cawthorne, Dix, Hallpike and Hood, 1956). Rabbits have been used also (Hood and Pfaltz, 1954), but these animals have not always proved satisfactory because of their susceptibility to infection of the external and middle ear after repeated irrigation with water. Caloric stimulation was also carried out in cats by Carpenter and Harter (1956) who were interested in vestibular function in cases of congenital cerebellar malformations. The experiments to be described on caloric stimulation in sheep were designed originally for the examination of the vestibular apparatus in sheep affected with scrapie (Palmer, 1957).

Materials and Methods

The first experiments were performed on an 18-month-old Welsh Mountain wether. When the technique had been worked out satisfactorily on this animal, three series of experiments were conducted. In the first series five nine-month-old Dorset Horn lambs were used, in the second four Dorset Horn adult ewes and in the third series four three-month-old Dorset Horn lambs.

Before a method for performing the caloric stimulation in sheep could be devised, it was necessary to determine the position of the lateral labyrinthine canal in relation to the skull, as in the experiments it is necessary to rotate this canal to a vertical plane. The bony labyrinthine canals of a sheep's skull were filled with a radio-opaque fluid (Myodil, Glaxo). The foramina in the petrous temporal bone were sealed with balsa wood cement, and radiographs taken of the labyrinth from both vertical and lateral aspects. The lateral labyrinthine canal was found to lie parallel with a line joining the nuchal crest with the supra-orbital part of the frontal bone. The plane of the dorsum of the head, therefore, represented a guide to the plane of the lateral canal.

As the purpose of the experiments was to alter the flow of the endolymph, it was necessary to hold the animal's head as still as possible. Stocks were made for this purpose so that the sheep could be held in a dog-sitting position, the head resting on a platform that could be raised and lowered vertically and also tilted at an angle (Fig. 1). The frame of the stocks was constructed of $1\frac{1}{2} \times \frac{1}{4}$-inch angle iron; the base plate was made of $\frac{1}{2}$-inch wood and the head rest was covered with aluminium sheet. Two slots in this sheet afforded apertures for the intro-

duction of a webbing strap that was tightened over the animal's nose. The sheep was held in position by an assistant, standing on the platform behind the animal, keeping the mandible on the head rest by holding the horns. The head rest was inclined at an angle of 53° from the horizontal.

In the account, the following terms are used. The irrigation of an individual ear is termed a " test " and two tests, one on each ear, constitute an " experiment ".

For caloric stimulation, the method employed was based on that described for man by Fitzgerald and Hallpike (1942). Water was led from a reservoir, a douche can, positioned about 1 foot above the highest point of the stocks. The temperature of the water was measured by a thermometer attached to a wooden plunger that was used for mixing. Before each test the water was brought to the necessary temperature by the addition of hot or cold water as required. The water was delivered from the reservoir through four feet of rubber tubing, 6 mm. internal diameter, to a silver Eustachian catheter (Down's, No. 2). A piece of polythene tubing, 2 mm. external diameter and 42 mm. in length, was fixed over the delivery end of the catheter to form a flexible extension. After the residual water (of unknown temperature) had been drained from the rubber tube, the catheter was inserted into the ear until resistance was felt as the catheter touched the anterior wall of the pinna. The tip of the ear and the catheter were then brought forward and the catheter was pushed in a further 5 mm. so that the effluent water was directed on to the tympanum. The water was then allowed to flow for the standard period of irrigation.

As the caloric test depends upon the temperature of the water at the ear-drum, this temperature is critical. The cold test was carried out with the reservoir temperature of 30° C, whereas in the hot test the water was at 44° C. Although the temperatures are the same as those advocated by Fitzgerald and Hallpike, they do not constitute the same gradient as in man. The body temperature of sheep is about 39° C, but that in man is about 37° C. However, the lower temperature of 30° C was found convenient for the cold test in sheep, whereas temperatures exceeding 44° C were not tolerated by the animals. As an additional check, on several occasions the temperature of the water was recorded as it was delivered from the catheter into a vessel. Depending on the temperature of the room, that of the water was between 0.8° and 1.8° C lower than the temperature recorded in the douche can.

Each ear was irrigated for 40 seconds, during which the first movements of nystagmus were usually seen. The duration of nystagmus was taken as the interval between the start of the irrigation and the end point, which was judged to be the time of the last beat in the rapid phase of the movement. During the irrigation the water was allowed to flow freely. On a number of occasions the water escaping from the ear was collected and the quantity in each test usually amount to about 80 mls. An interval of four minutes was allowed between successive tests.

Before and during the course of a series of experiments the external auditory canal was examined with an auriscope to ensure that there was no foreign material preventing the water from reaching the tympanum.

Results

Welsh Mountain Wether. Preliminary experiments were carried out on this animal at intervals of from three to eight days. A total of 43 cold tests were

successfully performed, but nystagmus was not elicited with irrigation at 44° C. The duration of nystagmus following irrigation at 30° C varied between 1 minute and 1 minute 50 seconds, and the direction of the quick phase was away from the ear being irrigated. The total number of nystagmus beats was counted on 27 occasions; the minimum frequency was 33 beats in 1 minute 25 seconds and the maximum was over 300 beats in 1 minute 30 seconds. Higher frequencies were associated with excitement of the animal by extraneous disturbance. The time of onset of the nystagmus after the start of irrigation showed considerable variation, earlier onset generally being associated with excitement. Two tests were performed with water at 20° C and the duration of nystagmus was 1 minute 30 seconds and 1 minute 45 seconds, durations similar to those obtained with water at 30° C.

When the technique of caloric stimulation had been satisfactorily established by these experiments, the next problem was to obtain a series of values from healthy sheep before applying the tests to animals showing neurological signs.

9-month-old Dorset Horn Lambs (*Nos.* 1-5). Twelve experiments were performed with the cold test, the time interval between experiments varied from two days to three weeks. Usually the sequence of irrigation was altered at each experiment, so that on one occasion the left ear was tested first and on the next occasion the right ear was tested first. The duration of nystagmus (at 30° C) varied between 1 minute and 3 minutes 10 seconds (Table I), there being also one result of 4 minutes when the head was not restrained in the proper position. No response was obtained in the right ear of sheep No. 4 after the ninth experi-

TABLE I

Duration of nystagmus after caloric stimulation (at 30°C) on five 9-month-old lambs. Fixating was not inhibited.

SHEEP No.	1		2		3		4		5	
EAR	L	R	L	R	L	R	L	R	L	R
EXPT. 1	2'55"	2'20"	2'55"	2'15"	1'45"	1'40"	3'00"	2'40"	2'30"	3'15"
2	4'00"	2'20"	1'55"	2'05"	1'55"	1'40"	2'05"	1'30"	2'55"	3'00"
3	2'30"	2'05"	2'00"	2'00"	2'15"	2'15"	1'25"	1'30"	1'35"	2'45"
4	3'10"	2'00"	1'30"	1'50"	1'55"	1'40"	1'25"	2'25"	2'05"	2'30"
5	2'40"	2'15"	1'40"	2'30"	1'50"	2'10"	1'35"	1'40"	2'10"	2'35"
6	3'00"	1'30"	1'30"	1'55"	1'25"	2'00"	1'30"	1'15"	1'35"	1'20"
7	2'20"	2'15"	1'30"	2'10"	1'20"	1'20"	1'25"	1'10"	1'20"	1'40"
8	2'45"	1'55"	1'35"	1'30"	1'45"	1'40"	1'35"	1'20"	1'30"	1'55"
9	2'20"	1'45"	1'35"	2'00"	1'10"	1'25"	1'40"	1'00"	1'20"	1'55"
10	2'40"	1'45"	1'10"	1'45"	1'30"	1'15"	1'35"	0	1'25"	1'30"
11	2'35"	2'00"	1'35"	2'00"	1'30"	1'25"	1'15"	0	1'05"	1'55"
12	2'30"	1'35"	1'40"	1'55"	1'30"	1'20"	1'10"	0	1'45"	1'35"

ment. No reason could be found for this, as on inspection the external auditory canal appeared normal.

Since there was such a wide variation in the results both between animals and in individuals, it was considered that emotional factors and release of adrenaline might be responsible. This possibility was examined by performing experiments on four animals (Nos. 1, 2, 3 and 5) before and after the intramuscular injection of 2 mls. of 1/1,000 solution of adrenaline hydrochloride (B.D.H.). The results are given in Table II and it will be seen that the administration of adrenaline caused no constant increase of duration.

TABLE II

Duration of nystagmus before and after the intramuscular injections of 2 mls. 1/1000 adrenaline hydrochloride. Caloric test at 30°C.

SHEEP No.	1		2		3		5	
	L	R	L	R	L	R	L	R
3 mls. Saline i/m	1'25"	1'15"	1'25"	1'25"	1'35"	1'40"	1'40"	1'15"
2 mls. Adrena-line i/m	3'00"	1'45"	1'35"	1'15"	1'40"	1'35"	1'55"	1'30"

Irrigations with water at 44° C were performed on several occasions with only one successful result. The procedure then used was to induce nystagmus with water at 30° C and as soon as the end point was reached the same ear was irrigated with water at 44° C. The direction of the "hot" response was opposite to that obtained with the cold test and the duration was 1 minute 15 seconds.

Dorset Horn Ewes (*Nos.* 6, 7, 8 *and* 9). The cold caloric test was performed on these animals. During the first two experiments the duration of the nystagmus did not exceed 2 minutes 30 seconds and it was realised that sometimes the sheep were fixating the eyes and thereby voluntarily inhibiting the movements. To prevent this fixating, one eye was completely covered while the eyelids of the other were approximated until only the scleral junction was visible to the observer. Movements of the eyeball were still apparent, but the animals were unable to fixate on any object in the visual field. This method of controlling the effects of fixating was used in all subsequent experiments.

Cold caloric experiments were performed 15 times on the four ewes, at daily intervals. The results are given in Table III. There was considerable variation of the duration of the responses from 1 minute 15 seconds to 4 minutes 15 seconds; the mean value was 2 minutes 14 seconds. The frequency distribution curve was skew and further statistical analysis was not undertaken.

TABLE III

Duration of nystagmus after caloric stimulation (at 30°C) on four adult ewes. Fixating was inhibited.

SHEEP No.	6		7		8		9	
EAR	L	R	L	R	L	R	L	R
EXPT. 1	3'00"	3'05"	2'30"	4'15"	2'40"	2'30"	1'50"	2'20"
2	3'30"	3'15"	2'50"	2'40"	2'25"	2'30"	2'15"	2'15"
3	3'10"	2'45"	1'45"	2'50"	2'25"	2'10"	1'55"	2'10"
4	2'55"	2'50"	2'10"	2'40"	2'40"	2'20"	2'10"	2'45"
5	2'30"	2'40"	2'50"	2'45"	2'20"	2'10"	1'45"	2'25"
6	2'00"	3'05"	1'55"	1'55"	3'00"	1'40"	1'30"	2'10"
7	2'30"	2'45"	2'50"	2'15"	2'30"	1'50"	1'45"	2'00"
8	1'45"	2'20"	3'05"	2'15"	2'55"	2'00"	0	2'30"
9	1'30"	1'45"	1'30"	0	2'15"	1'50"	0	2'10"
10	1'45"	2'20"	2'30"	2'40"	2'20"	1'50"	2'30"	2'00"
11	2'05"	2'05"	1'45"	1'50"	3'05"	2'00"	2'00"	1'50"
12	1'45"	2'30"	1'40"	3'05"	2'35"	1'40"	2'05"	1'45"
13	2'00"	1'30"	2'00"	1'50"	1'35"	1'45"	1'15"	1'30"
14	1'50"	2'35"	3'00"	2'20"	1'40"	1'30"	3'10"	1'50"
15	2'05"	1'55"	2'55"	2'00"	2'00"	1'25"	3'45"	2'00"

Dorset Horn Lambs, 3 months old (*Nos.* 10, 11, 12 *and* 13). The cold caloric tests were performed on these animals in order to determine whether there was any difference between the duration of induced nystagmus between old and young sheep. The head rest of the stocks was lowered to its minimum height which proved satisfactory for the smaller animals. Daily experiments were carried out for 14 days and precautions were taken to prevent fixating. Results obtained are given in Table IV.

The minimum duration of the nystagmus was 1 minute 20 seconds and the maximum 5 minutes 45 seconds, with a mean value of 2 minutes 49 seconds (compared with a mean value of 2 minutes 14 seconds with the group of adult ewes). The frequency distribution curves were skew and the results were not analysed further. The difference between the results obtained from the adult and young animals was not considered to be significant because of the considerable overlap of many of the individual values.

Discussion

The experiments showed that in sheep, thermal stimulation at 30° C of the external ear caused nystagmus, the direction of the quick component of the move-

TABLE IV
Duration of nystagmus after caloric stimulation (at 30°C) on four 3-month-old lambs. Fixating was inhibited.

SHEEP No.	10		11		12		13	
EAR	L	R	L	R	L	R	L	R
EXPT. 1	3'15"	3'00"	5'00	2'25"	3'30"	3'00"	3'30"	3'45"
2	3'15"	2'40"	5'30"	2'45"	2'30"	2'50"	5'45"	3'50"
3	2'45"	2'25"	5'50"	3'05"	3'40"	3'10"	3'50"	3'05"
4	2'25"	2'25"	5'30"	2'20"	3'35"	2'35"	3'15"	2'35"
5	2'20"	2'10"	5'30"	2'40"	3'10"	2'30"	2'30"	2'30"
6	2'40"	1'45"	2'55"	2'20"	2'40"	2'30"	4'00"	2'35"
7	2'10"	1'50"	3'20"	2'55"	3'05"	2'30"	3'15"	2'20"
8	2'00"	1'50"	4'00"	2'30"	2'35"	2'15"	3'00"	2'55"
9	2'10"	1'50"	4'40"	2'20"	2'10"	2'15"	2'00"	2'40"
10	2'05"	1'40"	5'30"	2'45"	2'05"	2'40"	5'30"	3'15"
11	1'45"	1'45"	4'15"	1'40"	2'05"	2'30"	2'45"	2'40"
12	2'10"	2'10"	3'00"	2'25"	1'55"	1'50"	1'55"	2'35"
13	1'40"	1'35"	5'45"	1'40"	3'05"	1'50"	0	2'30"
14	2'05"	2'30"	3'50"	1'20"	2'40"	2'00"	0	2'05"

ment being away from the side of the ear being irrigated. Except for a few occasions the cold caloric response was obtained regularly, but irrigation with water at 44° C resulted in nystagmus on only one occasion, and then the direction of the movement was towards the ear being stimulated.

Failure to obtain a result with the hot test is in keeping with the experience of Hood on rabbits (personal communication, 1955). This failure may be associated with the body temperature of these animals which is higher than in man. Inability to perform the hot test successfully in sheep precludes the clinical use of the principle of directional preponderance (see Fitzgerald and Hallpike), a method that relies on both hot and cold tests and is a sensitive indicator of slight functional derangements in the labyrinth.

In the experiments on sheep, interference of the nystagmic movements occurred when the animals attempted to fixate. In order to prevent this interference during experiments conducted on man, Jongkees (1949) advocated the use of Frenzel's glasses; under these conditions the patient is unable to fixate. However, Hallpike *et. al.* did not believe such inhibition was necessary.

Failure to obtain constant values for the duration of induced nystagmus in healthy sheep may be ascribed particularly to slightly movements of the animals' heads during the course of the tests. It was not possible to hold the head absolutely

immobile throughout all the experiments although as a rule the amount of movement was slight. In man, standard conditions for the test are obtained much more easily than with sheep, and in man the values of the duration of nystagmus on repeated tests usually show a large measure of agreement (Hallpike *et. al.*). In order to obtain such regularity in sheep, it would be necessary either to clamp the head firmly in position or to use a general anæsthetic, both of which methods would lead to practical difficulties. For instance, the depth of anæsthesia could not be gauged with certainty, and therefore the quantitative interpretation of the tests would be unreliable.

At present the cold caloric test in sheep offers a method of determining whether or not there is complete functional ablation of one of the peripheral parts of the vestibular apparatus, i.e. the labyrinth, vestibular ganglion or vestibular nerve. When such gross abnormalities are present there is a complete absence of response to the cold test on the affected side. As the hot test cannot be regularly performed in sheep, and as consecutive results with the cold test in an individual animal show little uniformity, the caloric response, as described, cannot at present be used to detect slight functional changes in this species.

Summary

1. A method is described for producing nystagmus in sheep by caloric stimulation of the labyrinth.

2. Nystagmus was elicited by irrigation of the external ear with water at 30° C.

3. The duration of the induced nystagmus, from the beginning of irrigation to the last nystagmic movement, showed variation both between and within individual animals.

4. In sheep the test is useful in detecting loss of function of the vestibular apparatus.

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REVIEWS

BLOODSTOCK BREEDING, by Sir Charles Leicester, London. Odhams Press Limited. Price 45s.

MAN'S veneration of horses surpasses that for all other animals with the possible exception of the dog. People of all degrees, be they rich or poor, come under the equine spell. They flock to shows and race courses, they talk of horses with the assurance of an expert and it matters little whether they have ever possessed one, ridden one or viewed its hindquarters from the seat of a dogcart or van. And the king of all horses is the thoroughbred. Selective breeding has been practised since the horse was domesticated and great changes in conformation, temperament and stamina have occurred. In regard to the thoroughbred selective breeding has been practised by breeders for two or three hundred years and in this country the first great step in this direction was the introduction of Arabian and Barb blood. The ideal of all breeders is to produce a horse which can surpass all others and their bible is the Studbook. The quality of the stock has been improved but the ideal animal still eludes the breeders. Much of the breeding has been empirical and founded on personal interpretation of genetical ideas or theories based on the conception that " like begets like." From the mass of records and statistics that have accumulated many theories have been propounded and our library shelves are replete with books on these matters. If selective breeding can bear good and constant fruit then it is reasonable to suppose that the key might be found in the wonderful array of past records which are available particularly those to be found in the Studbook. One of the shortcomings of the investigators is that they become so immersed in their studies and in their theories and statistics that their manuscripts become involved and ordinary people find difficulty in following the instructions. Sir Charles Leicester has devoted most of his life to this type of research and manifestly his book is most erudite, yet it is not beyond the comprehension of an ordinary student. The book is divided into two main parts. The first gives his views on the theory and practice of breeding and it gives the reader much food for thought and discussion. One gains the impression that his ideas are not rigidly fixed, he does not " ram " them down his readers' throats but he is content to give the basic factual information that he has accumulated and leaves his audience free to form their own opinions.

In the second part he details the histories of Derby winners of this century and of the members of their particular bloodlines or families.

There are many illustrations which are of great historical value and will beguile a T.B. enthusiast for many hours.

Sir Charles' book is one that will not be read and then put on the top shelf. It is one that will invite and indeed compel its owner to keep it near his chair so that he can consult it over and over again.

NOTICES

GLAXO LABORATORIES LTD. announce the introduction of Triplopen-s, a combination of Triplopen and streptomycin. Each single dose vial contains 500,000

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units of benethamine penicillin G, 250,000 units of procaine penicillin G, 500,000 units sodium penicillin G and 0.5 gram streptomycin. The product is available in single dose vials and is issued as a dry powder which on adding sterile water forms a very fluid suspension ready for injection. The preparation provides effective therapy for many cases of acute infection caused by staphylococci, hæmolytic streptococci, pneumococci and other sensitive organisms. It is of special value in sensitive conditions where a complete course of antibiotic therapy is required in one injection. Usually one injection is effective, but occasionally if the response seems incomplete, a second injection can be given after an interval of two or three days.

THE DISTILLERS COMPANY (BIOCHEMICALS), LIMITED announces a reduction in their prices for "Distaquaine" V Sulpha Tablets effective from Monday, 11th August, 1958.

The new prices can be obtained from the Veterinary Department, The Distillers Company (Biochemicals) Limited, Broadway House, The Broadway, Wimbledon, London, S.W.19. (Telephone: Liberty 6600.)

NEWS

MR. F. G. BROWN, M.A., M.R.C.V.S., Veterinary Adviser to Smith Kline and French Laboratories Ltd. (manufacturers of "Bifuran", "Neftin" and "Nefco"), will be leaving shortly on a month's visit to the United States. He will represent the British Veterinary Association at the annual convention of the American Veterinary Medical Association in Philadelphia. During his visit Mr. Brown will be conferring with veterinarians and other research scientists on the development of new veterinary products. He will meet many poultry experts at the Poultry Science Association meeting at Cornell University.

GLAXO LABORATORIES LTD. AND ALLEN & HANBURYS LTD. announce that in order to achieve a closer working arrangement between the two companies, Mr. H. W. Palmer, managing director, Glaxo Laboratories Ltd., has been appointed to the board of Allen & Hanburys Ltd., and Mr. C. W. Maplethorpe, managing director, Allen & Hanburys Ltd., has been appointed to the board of Glaxo. The two Companies merged on May 30th this year.